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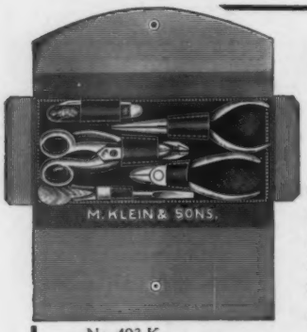

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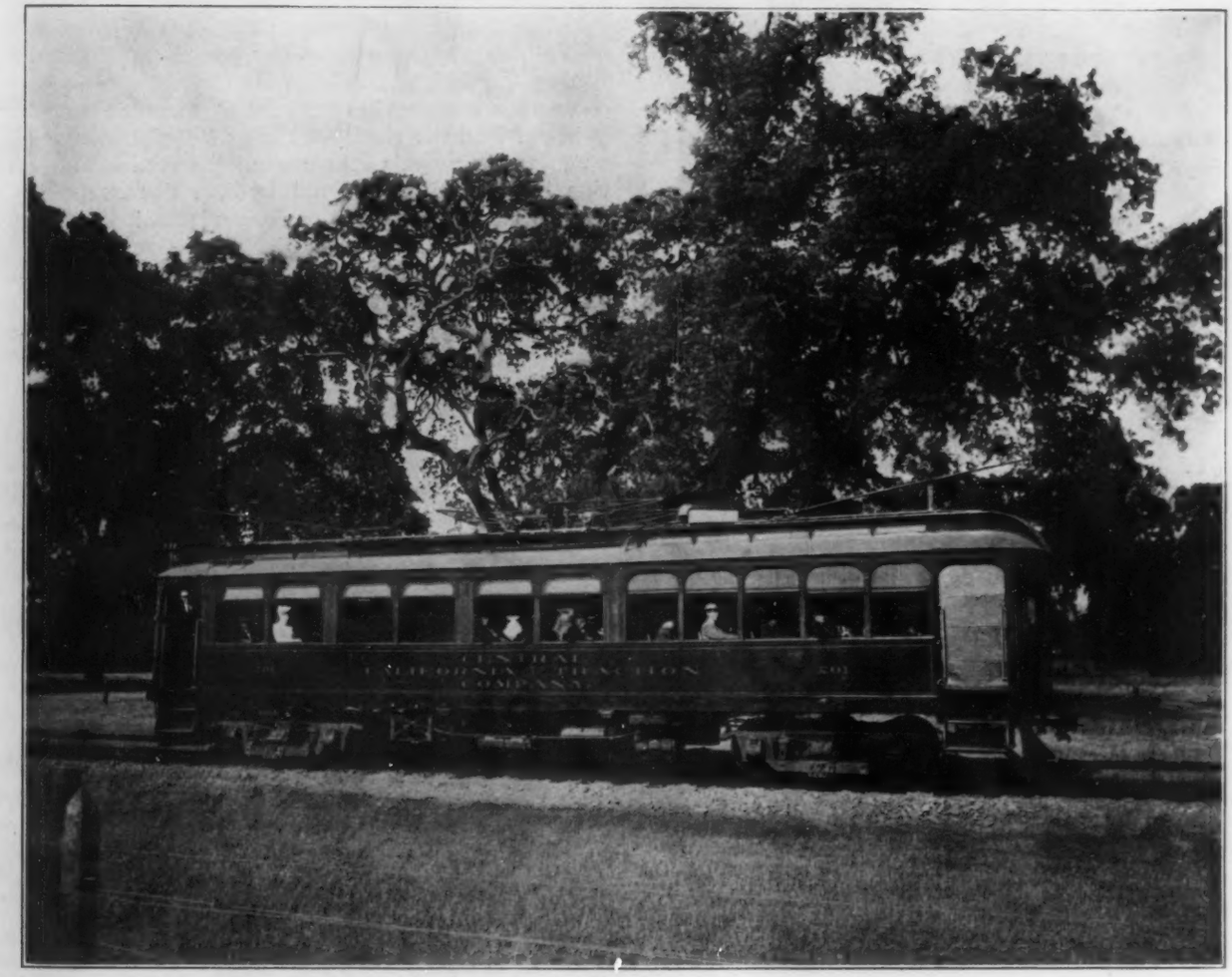
VOLUME XXII. SAN FRANCISCO, APRIL 3, 1909 NUMBER 14

DIRECT CURRENT 1200 VOLT RAILWAY EQUIPMENT.[1]

BY S. B. MCLENEGAN



1200-Volt Car of Central California Traction Company Equipped With 300 h. p.

THE past twenty years of electric railway development are amazing. As an illustration of this, a photograph from Denver, Colorado, shows the last of the old horse car lines now in operation, and in connection with which are some features which deserve special mention. At one portion of the line there is sufficient grade to enable the horse himself to ride in one direction, a platform being given up to him for that purpose. Here is a place where motor efficiency does not concern the company. So long as the horse retains his digestive ability the motive power may be regarded as reasonably efficient, but the price of hay and oats are matters of vital concern. As the opposite extreme of the picture you will note one of the 1200-volt cars of the Central California Traction Company at Stockton equipped with 300 horsepower. These two views are the extremes which

[1] Paper read before San Francisco Section, American Institute of Electrical Engineers, February 26, 1909.

illustrate better than words the progress achieved during the past twenty years.

We are, however, very far from perfection at this time. The slow and tedious process of evolution is still going on and we cannot tell what the coming twenty years will bring forth. Electricians have yet to devise a standard equipment upon which we may concentrate, but I believe that with the adoption of higher direct current voltages a very decided step has been taken toward this end. I sometimes look with envy upon our brethren of the steam roads. Every portion of their equipment is designed and constructed in accordance with accepted standards.

But it is a far cry back to the days of Stephenson, the father of the modern steam locomotive. Some of his experiments date back nearly a century, whereas many of us recall very distinctly the primitive types of Frank J. Sprague and others who occupy the same position in the development of electric railway motors. So far as the mechanical end is concerned we have already adopted many of the steam railway standards; the car body, truck, braking appliances and couplers having already been appropriated. The question of motive power is still complex and one which electricians have yet to satisfactorily solve. The requirements are not many. We need a motor which shall be efficient, economical and reliable in operation. In the railroad business there are troubles enough from without and we must avoid those from within.

The first cost of an equipment is not a primary consideration. Railroad companies can afford to pay a good price if the results are commensurate. By this I mean an equipment which shall stand up under the strain of everyday work with a minimum amount of failure and give results alike satisfactory in point of efficiency and maintenance.

With all the improvement made in direct current railway motors, the manufacturing companies until very recently have done nothing to improve the voltages hitherto employed. Practically every railway company using direct today is limited to 550 or 600 volts. Some of the longer lines have been forced to adopt alternating current, but with varying degrees of success. The General Electric Company has been the first to break away from the lower voltages by developing and placing on the market a motor not only capable of operating on 550 or 600 volts, but twice that amount of direct current. The guaranty of successful operation which went out with the equipment certainly indicated clearly that this company had faith in it and I take pleasure in saying that so far as my experience goes in the daily use of this system during the past year, it has fulfilled every reasonable requirement and justified everything said in its favor. The type used by the Central California Traction Company is known as the G. E. 205 and has a rated capacity of 75 horsepower at the voltage for which it was designed. This equipment should not be confused with the one employed on one or two Eastern roads which maintain 1200 volts on the trolley and have two 600-volt motors in series. This type employs 1200 volts straight on the motors.

The chief feature of this motor is the commutating pole which occupies the space between each of the four poles of ordinary railway motors. There are also some features of brush holder insulation which further distinguish it, but otherwise it bears all the outward earmarks of the best prevailing types of railway motors.

There is no indication of sparking at the commutator, either in starting, during acceleration or at full speed, and the commutator should give many years of service before requiring renewal. Many of the original carbon brushes received with the equipment, and which have been in service since June last, are still in daily use, and in these two matters at least the maintenance charges will be very low. All journals in the equipment from the axles upward, with the exception of the dynamotor, are lubricated by a grade of oil costing 20 cents per gallon in barrel lots and will operate upward of one thousand miles without re-oiling.

The standard equipment consists of four motors geared at a ratio of 23 to 51 for passenger service and 16 to 58 for freight service, and the former is designed to operate at a maximum speed of 50 miles per hour. Without load the complete car and equipment weighs about 70,000 pounds. At present the road is in operation between Stockton and Lodi, a distance of 15.5 miles, but there are extensions planned which will aggregate several times that length.

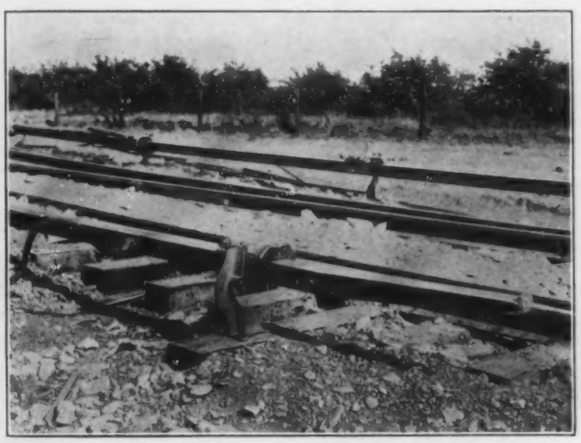
For a distance of two miles from the center of Stockton cars operate over an ordinary 550-volt line to a point where the private right of way commences. Over this section the maximum speed will not exceed 22 miles per hour. This feature is not objectionable, as it is very difficult to hold motormen operating high speed cars to the speed permitted by municipal requirements. So long as accidents are avoided, but little is said by authorities on this subject, but, when the fatal day arrives, the railway company permitting its cars to greatly exceed franchise stipulations, will find itself in an exceedingly difficult situation when brought into court. When the maximum speed is limited, as in this instance, to a moderate rate, it is not a difficult matter to show that cars were not operated at a dangerous speed, and, unless gross carelessness is shown elsewhere, a reasonable defense is always possible when accidents occur.

After reaching the private right of way outside of terminal points cars leave the trolley section and take power from the third or electric rail. Unlike others in use in California, this is known as the New York Central type, although instead of the bullhead rail conductor an ordinary 40-pound section is used, having about the capacity of a 400,000 c. m. feeder. An excellent view of this construction is shown in the illustration. In this you will note the rail is suspended from a malleable iron bracket which is spiked to a ten-foot tie. These are spaced twelve feet apart, or every sixth tie in the track. It is entirely practicable with this weight of conductor rail to spread the brackets and insulators fourteen feet apart, or, roundly speaking, every seventh tie in the track.

This will lessen the cost of construction materially without loss in stability. You will note the construction at crossings and switches. A section of the web about an inch in width and four feet in length is cut out and the rail end bent under heat in the shape of a sleigh runner. In order to prevent accidental contact with the live rail it is protected by a wooden covering between insulators. While no special trouble has

developed in the use of this, I do not consider it adapted in point of durability to the wet and dry seasons of California. It was predicted in some quarters that electrical trouble would result with a covering of this kind on a 1200-volt rail, particularly during the rainy season, but such has not been the case.

A much cheaper and more substantial covering can be made for this rail from ordinary rough lumber, cut in 3" and 6" widths and in lengths to suit the distance between insulators. This can be made up in the shops in the shape of a rectangular trough but without ends, and secured by either nails or screws through the side into a wooden filler fitted into the web of the rail, which prevents its removal. This may be further reinforced by a band of half oval iron around each end near the insulator. Any wooden covering should be dipped into a bath of hot asphaltum or other preservative which shall thoroughly impregnate the wood. This sort of covering is simple, inexpensive, and can readily be made up in the shop in large quantities and dropped into place from a work car as it passes.



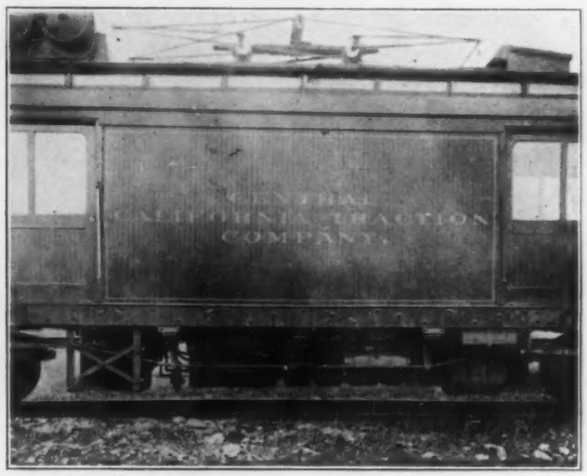
View Showing Construction of Third-Rail Shoe.

This type of third rail is very much superior to the ordinary exposed section. Repairs if any can be made by section men. There is no difficulty in replacing a broken insulator with current in the rail. One or two intelligent laborers are usually instructed for this purpose and become entirely satisfactory for all repair work. This consideration alone is of great importance in the use of the third rail wherever it is possible to adopt it, as maintenance charges are very low.

With overhead wiring it is necessary to employ a large force of linemen, and on the larger roads it is a heavy item of expense, all of which is done away with in the use of the third rail. This construction should not exceed $3100 per mile of track complete, which does not exceed the cost of good trolley construction. At best the trolley is one of the weakest features of electric railways, and, as a rule, delays to traffic are two to one arising from that source as compared with other causes.

As shown in the view of one side of an express car, all apparatus is suspended from two sub-frames of angle iron. These are rectangular in form and bolted from each of the four corners to the sills of the car. This has two advantages—first, it does away with cutting and weakening the frame of the car and, second, it makes it possible to insulate every portion of the apparatus from the floor of the car. With ordinary construction it is not unusual to find a "live" car during the rainy season, a feature which must be avoided in the use of the higher voltages. Suspended from the sub-frame on one side is the dynamotor and dynamotor contactor box.

Probably the most distinctive feature of the 1200-volt equipment is the dynamotor. The armature carries a commutator on each end of the shaft. The motor or 1200-volt end takes current direct from the third rail and the other generates and delivers 600 volts for the operation of the auxiliary equipment. The armature coils for the 1200-volt end are on top while those connected with the 600-volt end are on the bottom of the same slot. The dynamotor has a rated capacity of 10 kilowatts and the current generated operates the motor control circuit, lights, air compressor and heaters. This last apparently was not contemplated by



Side View of Express Car Showing Method of Suspending Apparatus.

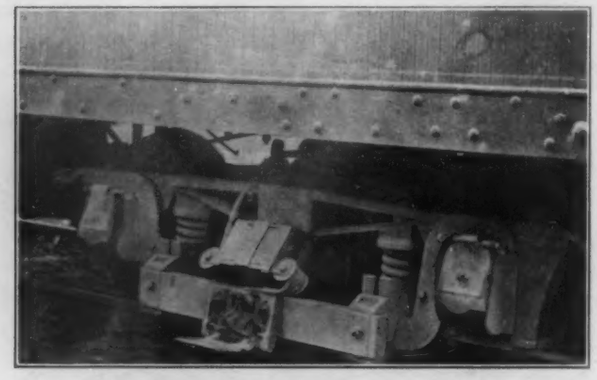
the manufacturing company, but when the subject of heaters arose it was not deemed advisable to permit the use of 1200 volts above the floor where heaters are necessarily located. The dynamotor armature is lubricated by a special grade of oil on account of the high speed at which it revolves. The dynamotor contactor box next adjoining contains two contactors, one 600 and one 1200 volt, which control admission of current to the dynamotor, or the reverse, according to the section of the line in which the car is operating and the voltage employed.

When the car passes from the 550 to 1200-volt section, there is a short stretch of "dead" trolley, in passing under which the 550-volt contactor drops out automatically. At the instant the third rail shoe makes a contact with the electric rail the 1200-volt contactor closes, causing the dyanmotor to start furnishing, as already stated, current for the auxiliary circuits. When the conditions are reversed and the car passes from 1200 to 550-volt circuits, the 1200-volt contactor opens automatically and the dynamotor ceases to operate as the auxiliaries then take current direct from the trolley. In this case, however, the motorman closes the 550-volt contactor by means of an electrically operated

switch in the cab before the trolley current is available. Both contactors cannot be closed at the same time so long as they are in operating condition. In passing from either trolley to third rail, or vice versa, the motorman also throws what is known as the transfer switch, which is also electrically operated. This device admits current from either the trolley or third rail and cuts off the one not in use. Both of these movements are made while the car is under full speed.

The master control consists of the ordinary Sprague-General Electric type M controller located in the cab at either end of the car and both connected by a ten-wire cable carried in loricated conduit. By means of current through the master controller and cable, the contactors, fourteen in number, are electrically operated. These establish motor control in individual cars whether operated singly or in multiple.

The location and construction of the third rail shoe, wooden shoe beam for insulating purposes and fuse box are shown in the accompanying view. The fuse box is built up of horn fibre and is supplied with a ribbon fuse. Blowout coils are provided where shown to take care of arc when from any cause the fuse burns out.



Wood Insulating Shoe Beam and Fuse Box.

We are still using the original cast steel shoes received with the equipment. It has been recommended that cast iron be used for this purpose, for the reason that in the event of a shoe catching a bracket it might tear the beam off or cause a derailment. Cast iron being the weaker it would probably result in nothing more serious than the loss of the shoe itself. It is but fair to add, however, that nothing of this kind has ever occurred in our experience.

An unusual incident occurred recently in connection with the third rail shoe. By a combination of circumstances a shoe picked up an iron barrel hoop which had found its way in a position where this was possible, causing a dead short between the shoe and track. Unfortunately this occurred near the 1200-volt sub-station and the violence of the short caused an armature coil to raise and foul with one of the pole pieces of the generator. This may have been caused by a poorly fitting slot stick which was forced out by the violence of the jolt. It is our judgment that horn fibre should be used in the slots of 1200-volt machines on account of its non-shrinking qualities.

The only external feature which distinguishes a 1200-volt motor generator from the ordinary type is the interpole arrangement. We have found it advisable to use a fibrous barrier to protect brush holders from the arc resulting from possible line shorts. In an emergency we have used a 1200-volt motor generator on a 550-volt circuit, but it is necessary to provide separate field excitation in that event.

Every part of the equipment, down to the smallest detail, is standard on each car as regards location. The bolt holes in the sub-frames are located by template securing uniformity in every car of the system for each portion of the apparatus. All the wiring is in loricated conduit, securing full protection from water and other deteriorating influences. Motor leads are encased in brass wire armor, but it is doubtful whether this is advisable. Unless carefully watched they sometimes chafe through the insulation, resulting in shorts of a most disagreeable kind. A good quality of rubber hose is preferable for this purpose and in my experience it has given the best results.

The motorman's cab located on the left side of each end is completely enclosed while the motorman is at his post. On the opposite end the door swings back against the controller and permits the full use of both sides of the platform for passengers entering or leaving car. In the motorman's cab within convenient reach are all the electrically operated switches required for the operation of the auxiliary equipment. They are all designed to be "fool proof" and there is no combination which can be worked by a motorman which will damage the equipment if improperly handled. The most serious result following improper handling will be stoppage of the car.

It will now be in order to discuss briefly the practical results obtained in the use of 1200 volts of direct current as compared with the older types of 550 or 600-volt motors. The first cost of a 1200-volt equipment is considerably more than the present standards of the same rated capacity. If, however, this type will perform the same duty at a lesser cost in power and maintenance it must certainly receive future consideration, but if such is not the case no inducement will secure its adoption. I do not consider 1200-volt motors adapted or necessary for ordinary street-car transportation. The present standards are entirely satisfactory and for various reasons voltages should be maintained as low as possible for the best interests of all concerned, particularly in the larger cities. For interurban service of any magnitude, say, roads of twenty-five miles or upwards in length the higher voltages can be employed with more satisfactory results.

The constructed portion of the Central California Traction Company is hardly of sufficient length to indicate the motor's efficiency, but with extensions planned there is every reason to believe that the results will amply justify the continued use of the 1200-volt equipment. We were given an excellent opportunity to make tests of the comparative efficiency of the G. E. 73 railway motor operating at 550 volts and the G. E. 205 at 1200 volts, both motors having the same rated capacity. Inasmuch as the latter was not fully developed when our road was otherwise ready for operation the General Electric Company furnished a temporary equipment of the G. E. 73 type which were new. A temporary sub-station was also furnished operating at 550 volts on the site of the future 1200-volt station. This combination furnished identical conditions except that the generators of the

Stockton sub-station operated in parallel with the interurban plant, which gave 550-volt operation every advantage.

Under the above conditions the power consumption per car mile for a period of six months averaged 5.23 kilowatt hours. With 1200-volt operation during the following six months our power consumption per car mile fell to an average of 4.74 kilowatt hours, a saving of 9.1% in power. Under existing conditions our 1200-volt generators are not working at the most efficient point. During fully one-third of the time the machines are without load, and during the remainder the load is hardly one-half the rated capacity of the machine. It is unnecessary to state that the best results cannot be expected under the circumstances outlined.

Power consumption is measured on the A. C. side of motor generators, therefore the above figures include not only generator, third rail and track losses, but power consumed at car. According to our records it requires about 150 amperes at 1200 volts to start and accelerate a given car, gradually dropping back to 70 amperes at full speed. The important factor in the use of 1200 volts, aside from that already stated, lies in the elimination of sub-stations in lines of considerable length.

The cost of operating a sub-station, exclusive of interest and fixed charges, is about $300 per month, and when once established this expense becomes practically a fixed charge itself. If, therefore, one substation operating at 1200 volts can be made to perform the same work ordinarily requiring two 550 or 600-volt stations and at the same time effect a saving of from 10% to 20% in power, it will best show what this new system is expected to accomplish.

The question of earnings per car mile is hardly under discussion at this time, but, as a matter of information touching upon the subject in general, during the year 1908 our earnings from passenger sources alone were 35.5c per car mile, with total operating expense of 14.0c per car mile. The cost of operation, exclusive of fixed charges, for the year amount to 38.4% of the gross earnings. This, you will understand, does not include freight and express service, which is handled and accounted for separately.

Our experience with 1200-volt operation has now covered a very hot summer followed by a wet winter, both of which have been extremes and of a character to test insulation to the fullest degree. Actual service conditions alone will mark the success or failure of an electrical equipment. The summer heat which varied from 90 to 105 degrees Fahr. for weeks was a hard test for this new equipment, yet to the best of our observation after a daily run of 200 miles or more every day in the week, the temperature of armatures and fields rarely exceeded 150 degrees Fah. At this living temperature insulation should stand almost indefinitely. It is safe to say that more trouble results from heating, overworking or overloading motors than everything else combined. This is directly the result of bad management and should not be laid at the door of the electrician. Whether it be a man or a machine, if persistently overworked the result is the same. Our experience during the winter has been equally satisfactory. It has been necessary at times to operate in places where tracks were covered with water to a depth of five or six inches. While ordinary prudence was observed under these conditions, no special precautions were taken other than to provide against wheel wash and to run slowly. Under both extremes the 1200-volt equipment has given less car failure than I have ever experienced during my connection with electric railway work. We have yet to lose a field, armature or other electrical part by a burn-out or any other cause.

I feel safe in saying that 1200 direct current operation has come to remain. It is no longer an experiment. There will doubtless be improvements of a minor nature, but I question whether direct current voltages will ever greatly exceed this point. The pioneer work has been accomplished and from a practical standpoint the results are certain.

TIMBER SEASONING AND WOOD PRESERVATION.

In recent years the importance of preserving timber from decay by the use of various antiseptics has been generally recognized in the United States. The value of properly seasoning timber before such treatment is not so generally known, though it is one of the most important features of the treatment.

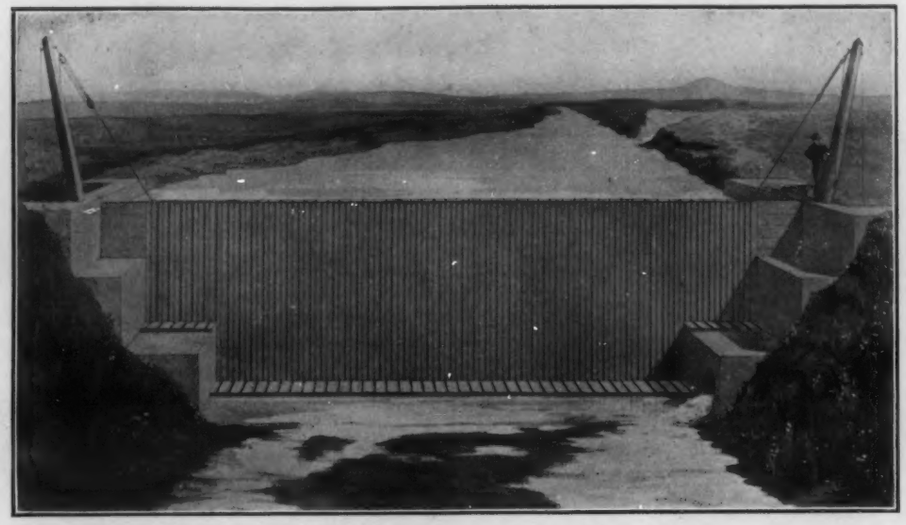
There are three main advantages to be derived from the proper seasoning of timber, namely: The increase in strength of the timber, the greater ease of injection of antiseptics for preserving the timber, and the saving in freight charges due to the decreased weight.

From thorough tests made by the Forest Service on various pieces of timber, it appears that thoroughly air-dry or seasoned timber has about double the strength of the green material. It is well known to all operators of wood-preserving plants that antiseptics are not only difficult to inject into green wood, but that it is practically impossible to obtain a uniformaly satisfactory treatment of such material at an economic cost, for the purpose of insuring a prolonged life.

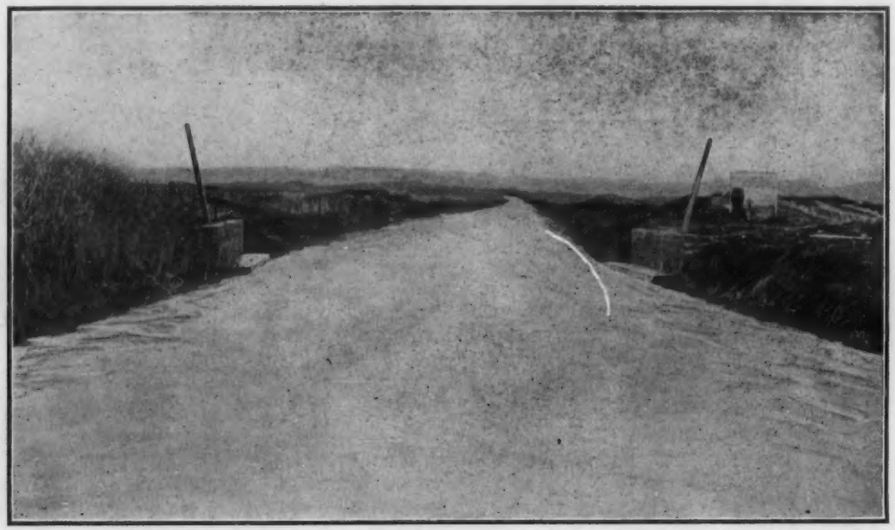
The last item would at first seem too trifling to be worthy of discussion, but from data obtained only recently it appears that western yellow pine lost 50 per cent of its green weight after three to five months' seasoning. This means a saving of 50 per cent of the freight charges and a corresponding saving in the handling of the timber, and is therefore a far too important point to overlook.

Considering these three points, it will be seen that there is not only a material saving in the seasoning of timber, but also a proportionate increase in the value of timber as a structural material. The seasoning of timber is never an expensive operation, even when done artificially. In the southern parts of the United States, a satisfactory degree of seasoning could be obtained by exposure of the timber to the air for a period of three to six months. In some of the Northern States, however, a somewhat longer period is necessary to secure satisfactory results.

A reinforced concrete yacht has been in commission for eleven years near Baltimore. The boat is a two-masted schooner, 65 feet long, 16 feet beam, and drawing 14 feet of water. It is particularly sea-worthy in a stiff breeze or heavy sea.



View of Dam and Canals from Below. (This View Shows the Needles Raised in Position and the Calking Timbers Inserted. The Head is 14 feet).



View Showing the Dam Open After the Needles Have Been Lowered.

Mocho or Main Line Drainage Canal in Winter.

Mocho or Main Line Drainage Canal in Summer.

NEEDLE DAM, PLEASANTON RECLAMATION PROJECT, CALIFORNIA.[1]

BY JAMES K. JAMES,
Assistant Engineer, Pleasanton Reclamation Project.

Within the last few months there has been constructed in connection with the Pleasanton Reclamation Project, California, a movable dam, which, though of moderate size, has several points of interest.

The Pleasanton Reclamation Project was organized to undertake the development of the Livermore Valley farm lands of the Alameda Sugar Company. The reclamation of about 5,000 acres has been accomplished by the construction of earth levees and canals to control and carry away the occasional floods. Up until 1906 the entire country thereabouts was partly under water at certain seasons and at all times of a marshy nature; but the efficient canal system now installed has turned it into one of the best drained and most fruitful large farms in the West. The reclaimed land sells at about $250 per acre.

A source of no small annoyance and expense in miantenance developed from the growth of aquatic vegetation in the canals during the summer months when the flow was small. To provide a remedy for this trouble it was proposed in 1907 to build a dam across the main line drainage canal in order that the water may be kept sufficiently deep in all parts of the channel during the dry season to completely drown out the vegetation. Incidentally, it was in recognition of the importance of creating a means by which the summer flow might be utilized, by allowing it to accumulate for such periods as would be necessary to collect a body of water large enough to be advantageously used for irrigation purposes. The new facilities provide for a storage supply of over 150 acre feet, which is held in the canal basins and may be drawn upon as occasion demands.

To comprehend clearly the significance of the particular design and construction adopted for this dam it would be best to consider briefly the works to which it has been added.

The canal works include seven miles of main line and five miles of tributaries. The drainage area supplying the canals is about 200 square miles, and the fluctuation between the dry and wet season flow is considerable. The main channel is designed to carry a maximum flow of 5,000 cubic feet per second. Briefly described, it has a bottom width of 34 feet; depth, 12 feet; grade, ⅛ of 1 per cent. The material excavated during its construction was thrown to either side, and levees built up from seven to eight feet above the level of the surrounding fields. A dam across the Mocho—main line canal—just below the junction of the Alamo and the Mocho, will back the water in each canal for a distance of several thousand feet.

The situation is unique, inasmuch as the canals are still subject to floods, provision for which is made by designing a movable type of dam, which may be, in case of sudden flood, immediately released, falling to a horizontal position on the floor of the canal and leaving an unobstructed course for the water. The head to be sustained is 16 feet. After the floods have subsided the dam is raised into position and the canals allowed to fill to the tops of the levees. The summer flow was increased by boring 12 artesian wells and leading them by underground tiles into the canals above the dam. Using a movable pumping plant (traction engines and 15-inch centrifugal pumps moved along the roads on the canal levees) it will be possible to irrigate the entire 5,000 acres. Gates inserted in the levees will also permit of gravity application at certain points.

Any variation in the summer flow may be regulated at the dam through a gate valve located in the walls, and by flash boards on the third level as shown in the illustration.

In choosing a type of movable dam the following conditions were considered: (1) A head of water of 16 feet to be sustained; (2) safety and ease of maneuvering in case of sudden and unexpected rises in the stream; (3) it should be maneuvered by the aid of the natural forces of the water course; (4) it should be sufficiently tight; (5) it should be composed of strong parts; (6) it should afford no obstacle when collapsed to the passage of floods; (7) it should be economical in regard to cost and operation; (8) scour to be guarded against below the dam; (9) no difficulty should be anticipated in lowering the dam on account of deposits of silt or sand on the floor.

Gates involving the principle of the bear-trap were found to be too costly, besides requiring considerable time to lower. The Chanoine wicket or shutter dams were also found to be expensive and the parts difficult to repair in case of accident. The Poiree Needles were subject to two objections: (1) The height was unfavorable to the use of needles; (2) continual watchfulness at certain times and danger of submersion. A type of dam was finally evolved answering the requirements and which was essentially a combination of the Chanoine wicket and the Poiree needle. It is in many respects a radical departure from dams of those types now in operation. The high head sustained is to be particularly noted. Among the salient features are: The substitution of steel channels for the wooden needles of the old type; the new method of holding the needles in place; the relative ease in lowering and raising and the low cost of construction.

Substructure—The foundation of the Needle dam consists of concrete masonry and imbedded and attached metalwork as shown by Figs. 1 and 2. Broadly speaking this work may be divided into (1) the abutments at each end of the dam, and (2) the foundation between the abutments.

Considering first the abutments it will be seen from Figs. 1 and 2 that each consists of 30 feet of concrete retaining wall. These walls have a height of sixteen feet and are carried up in two steps with horizontal offsets of six and four feet respectively. By stepping in the walls in this manner the canal section was closely adhered to. The change in section at the dam is therefore small and scour to the canal banks due to this cause is reduced to a minimum. Both the vertical and horizontal portions of the abutments are laid with 12 inches of concrete and reinforced with ¼-inch round rods, 12 inches on centers which run continuous from top to bottom. The ends of the abutment walls turn into the bank at right angles with the direction of flow, and are carried back into the natural material to cut off water which might filter through the earth behind the abutments.

[1] California Journal of Technology.

The foundation between the abutments consists of a 12-inch floor slab. The concrete was laid directly on the hard clay bottom of the canal and reinforced both longitudinally and transversely with bars spaced 12 inches center to center. Along the upstream face canal was first carefully scraped and a firm bottom prepared for the floor slab by removing the overlying sand, gravel, and softer top parts till the firm hardpan was reached. The flow in the canal was carried over the work by means of a flume. The excavation for the

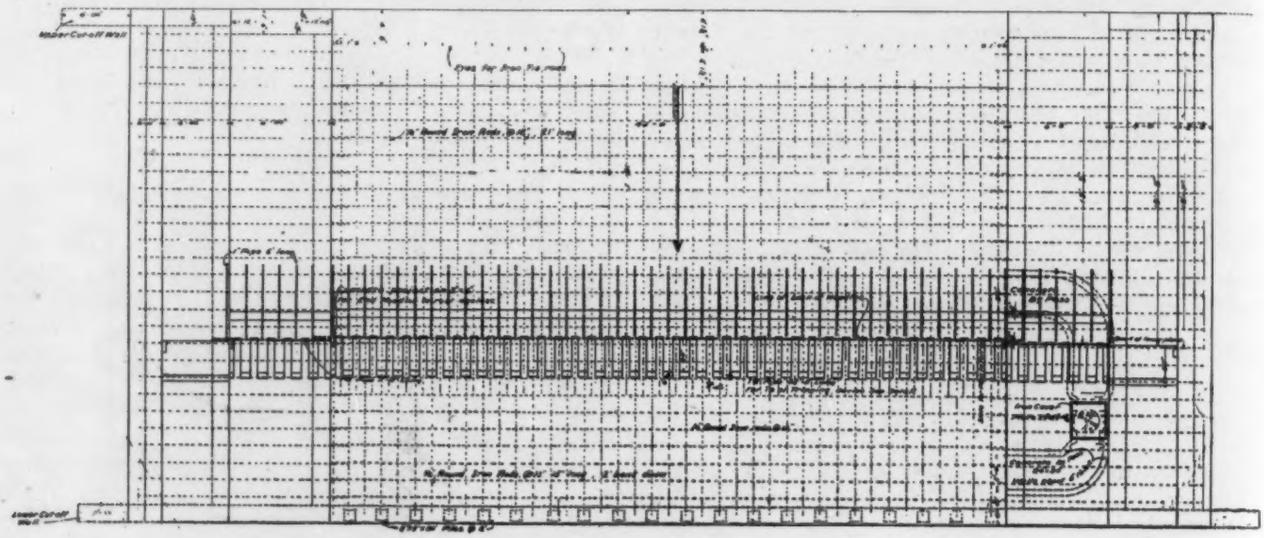


Figure 1. Foundation Plan.

a prismoid of concrete, 4½ feet wide by 5 feet deep, forms an upper cut-off wall. Similarly a lower cut-off wall is provided along the downstream face, the dimensions of which are: 1½ feet x 6 feet. This latter prismoid is imbedded in the tops of 8-inch x 8-inch piles, 20 feet long, 2 feet on centers and extending in a row the length of the dam. Figs. 1 and 3. The wing cut-off walls was then carried to the proper depth. By giving the bottom of each cut-off wall a slight slope towards the left abutment and locating a sump at each of these points to receive the suction hose leading to the pumps it was possible to keep the excavation entirely free from water. The seepage water was thus drained along the bottom of the cut-off wall

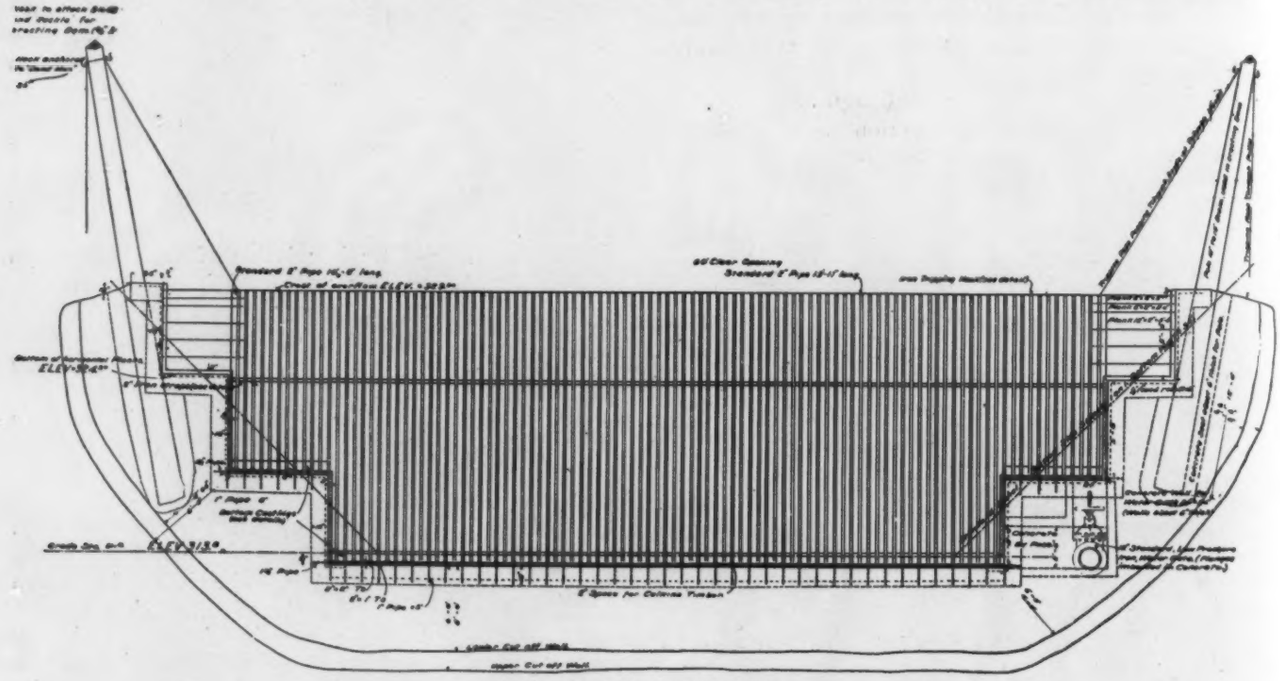


Fig. 2. Downstream Elevation.

walls of the abutments were carefully joined by the cut-off walls of the foundation.

The excavation work incidental to the construction was not unusual, but the method used in keeping out the water may be interesting. The bottom of the excavations to the sumps and lifted out by the pumps which were kept running continuously during the construction. The canal banks were also excavated to a shape ready to receive the concrete for the abutments.

After the excavation was complete a pile-driver

was lowered into position and the piles driven in a row along the lower toe. Nearly all the form lumber on the dam was used a number of times and a comparatively small amount was required. The offsets in the abutments afforded a support for the moulds for the upper portions of the walls and reduced greatly the number of timbers necessary for bracing. The forming and metalwork having been set in place, the entire substructure was concreted; working from the foot of the right abutment across the floor slab and upper and lower cut-off walls. The sump holes were the last part of the foundation to be filled with concrete, after which the abutments and wing walls were built up.

The concrete used in the floor slab and cut-off walls is a 1:2:4 mixture, and in the abutments the propositions are 1:3:6, the constituents being Santa Cruz

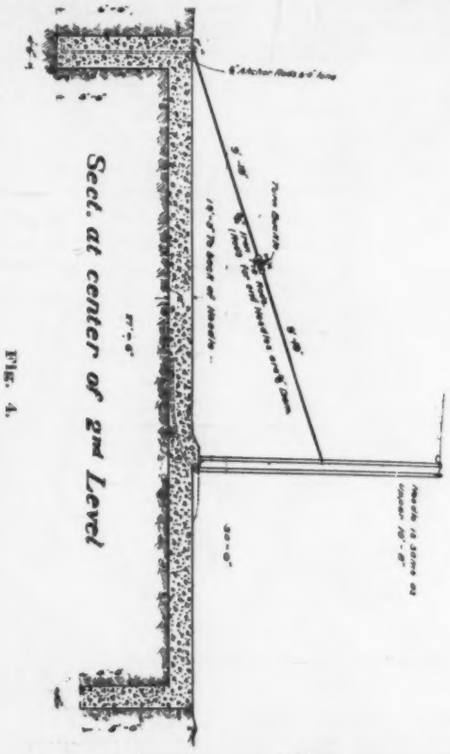


Fig. 4.

Portland cement, Monterey sand and screened crushed limestone that passes a 2-inch ring. The mixing was done by hand.

Foundation Metalwork—Upon the top of the floor slab, and built as a part of it, is a 3-inch x 36-inch sill. This sill extends the length of the dam along a line at about the two-third point from the upper toe. A 2-inch round iron rod traverses the center of the sill, and besides being imbedded in the concrete of the latter, is securely anchored at intervals of 12 inches by stringing on pipe T's into which tie pipes are screwed and bent down into the foundation masonry. This is indicated in Fig. 5.

Of the two vertical units of the dam proper, one, that on the downstream side, called the tripping device, is composed of 15-foot 10-inch length of extra heavy 2-inch pipe, which is provided at one end with a journal box enveloping the rod in the sill. These journal boxes of the tripping device are also pivoted on 12-inch centers along the rod and spaced midway between the anchors. The journals are essentially 2-inch x 2½-inch pipe T's; the body of which is strung about the rod, and into the collar is securely screwed the tripping pipe. To enable the journals and attached pipe to describe a quadrant about the rod as an axis and to allow the pipe to assume a horizontal position

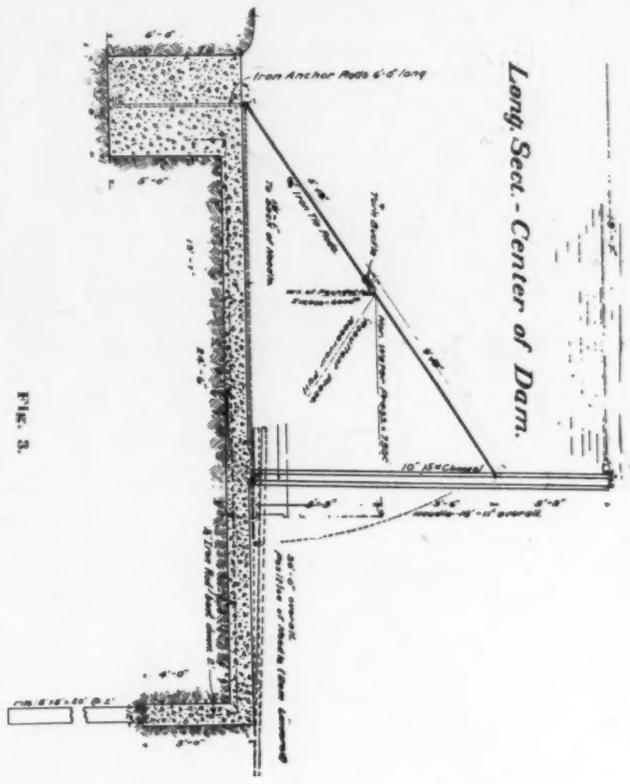


Fig. 3.

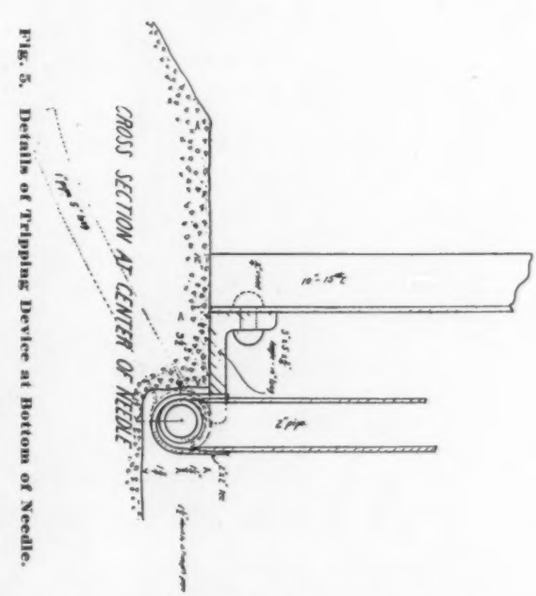


Fig. 5. Details of Tripping Device at Bottom of Needle.

on the downstream floor when the daw is lowered, the sill has been slotted on the downstream face. These slots, moreover, serve as a guide to prevent adjoining pipes from fouling one another when falling to the floor (Fig. 7). That portion of the sill which is upstream from the rod, however, is made of solid section, for upon its face will rest the superstructure (Fig. 5). Details of the tripping device and pipes are shown by

Figs. (6) and (7) and need not be described further except to state that on the first step of the abutments they are similarly placed as on the main floor slab.

Iron Anchor Rods—½-inch anchor rods, 12 inches on centers, are built 6 feet into the masonry of the upper cut-off wall and extend in a line the length of the dam. The upper ends of these rods terminate in eyes which project 2 inches above the floor. Through the eyes an iron bar is strung, the purpose of which is to serve as a support and pivot for the inclined tension rods, forming a part of the superstructure and to be described later.

Concrete By-Pass—In order to regulate the flow when the dam is raised a concrete by-pass has been provided. The intake is in the abutment wall at the floor level and upstream from the line of needles. The passageway is 24 inches square and is operated by a 12-inch standard low-pressure iron water gate, whose flanges are imbedded in the concrete of the pass. The outlet is similarly situated in the abutment wall, only at a point downstream from the line of needles. Figs. 1 and 2.

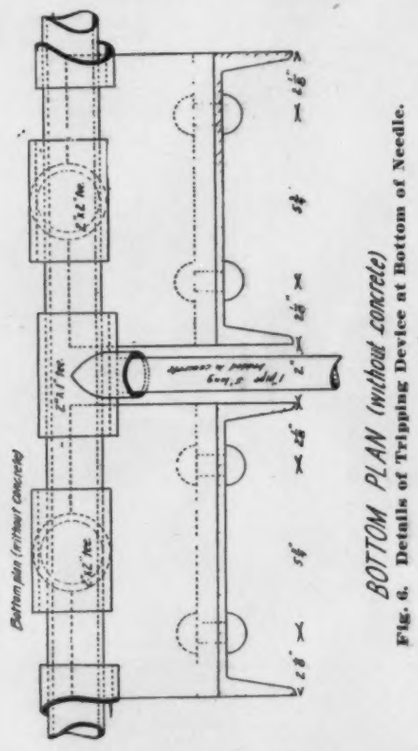


Fig. 6. Details of Tripping Device at Bottom of Needle.

Poles to Facilitate Erection of Dam—Fir poles have been imbedded in the concrete of the abutments, one on each side and located slightly downstream from the line of needles. The tops of these poles are provided with iron hooks between which a cableway may be strung (Fig. 2).

The foregoing cover the principal parts of the foundation metalwork.

Superstructure—The movable dam proper is secured to the foundation thus prepared. A unit of this Needle dam consists of these essential parts:

A needle which is a 10-inch, 15-pound steel channel. These channels are 15 feet, 11 inches in length. Riveted to the outside of the web at one extremity is the 3-inch leg of a 5-inch x 3-inch x ¾-inch standard angle iron. These angle irons are cut the width of the channel and so fitted to the latter that the back of the projecting leg is flush with the end of the channel. A 3-inch semi-circular seat is scalloped out of the 5-inch projecting leg as shown by Fig. 8. Two-thirds of the height of the needle from the angle iron is fastened a standard U-bolt, as shown by Fig. 9, into which fits the eye of a ¾-inch round tie rod. The head of the U-bolt projects from the inside of the channel web, between the flanges. Each tie is composed of two 9-foot 10-inch lengths joined by means of a turnbuckle to allow any adjustment in length. The two free ends terminate in eyes, one of which fits into the U-bolt on the channel. The other eye is pivoted about the horizontal bar which traverses the floor of the dam on a line above the upper cut-off wall. (Figs. 3 and 4.)

When the channel is raised the U-bolt forms the axis of rotation for the eye of the tie rod. The tie assumes an angle of about 45 degrees as the channel becomes vertical. At this point the long 2-inch pipe of the tripping device is revolved about its axis and also swung up to a vertical position. The bottom of the channel is forced slightly downstream by the water pressure until the semi-circular seat arranged on the projecting angle leg engages about the journal box at the foot of the tripping pipe. The pipe and the channel are the same length, so when both are vertical the tops coincide and may be fastened together by a hook (Fig. 4). The channels are thus supported at the bottom by resting on the sill and bearing against the journal boxes of the tripping device. At the top they are held by the inclined tie rods. When the dam is filled with water the needles and tripping pipe have a slight downstream batter, so to lower the dam it is only necessary to remove the hook joining the top of the needle with the top of the pipe to cause the latter to overturn and swing into its respective slot in the

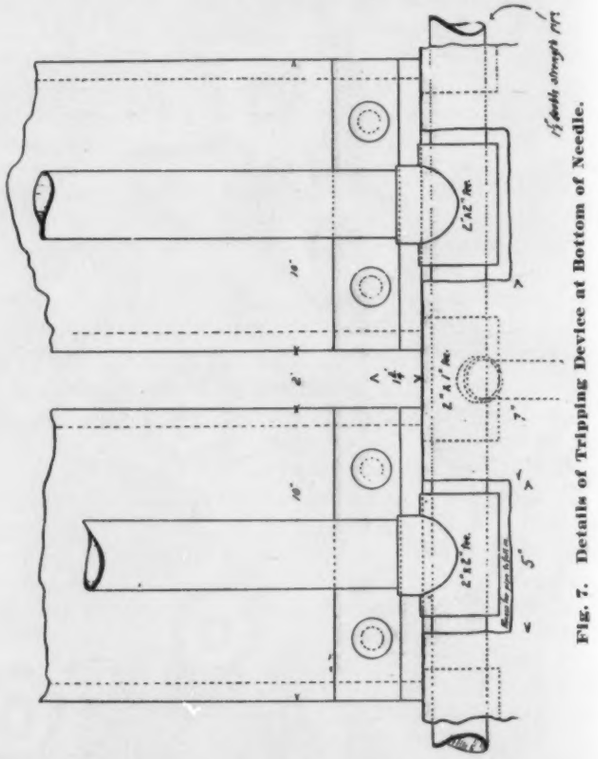


Fig. 7. Details of Tripping Device at Bottom of Needle.

floor slab. The needle now has no support against the water pressure at the sill and the bottom slides downstream till the whole needle finally falls into position on the floor. The needles when down lie below or downstream from the sill; therefore are protected by it. The sill, in turn, is as low as the canal bottom above and below the dam; hence offers no obstruction to the flow of water.

The dam is formed by a series of these needles, extending across the canal, each unit being independent of its neighbor. The needles are 10 inches wide and spaced 12 inches on centers, leaving a 2-inch space between adjacent members. This prevents needles hitting one another during maneuvers. V-shaped calking timbers may be inserted in these spaces to make the dam watertight.

To Raise the Needles—Between the two poles projecting upwards from the abutments a cableway is stretched. By means of a trolley the hoisting sheave is then shifted across the cableway to a position above the needle to be raised. Over the sheave passes a chain having a hook at its free end. At the top of each needle is a handle. By placing the chain hook in this handle and pulling on the free end of the chain the needle is raised from the floor. After being raised nearly into position, it is left suspended. By a similar arrangement the tripping pipe is raised, caution being exercised to engage it into the semi-circular seat in the angle iron at the bottom of the needle. The pipe is then closed up to the needle and the two hooked together at the top. This operation is repeated till the 52 needles composing the dam are all raised.

The upstream arm of each tripping hook is extended several inches beyond the flanges of the channels and the projecting arm bent with a lip. A timber float is run transversely the length of the dam, directly under these lips of the tripping hooks. The buoyancy of the water will always keep the float at its surface and it is so arranged that when the water reaches nearly to the top of the dam the floats lift the hooks sufficiently to disengage the tripping pipes and the channels. This construction is best illustrated by Fig. 10. The pipes then swing downstream and are followed by the needles.

The experience thus far gained with this dam indicates that its operation will be speedy and sure, although it has not as yet had sufficient trial to demonstrate how it will behave under all conditions or what unthought-of difficulties may arise.

Cost—Under favorable conditions a dam of this type may be erected for $100 per lineal foot of dam.

Attention is called to the advantageous distribution of stresses in this special design.

Considering the dam as a whole the following calculations will show that the lines of resultant pressure lie within the center third of the profile.

Taking moments of area about lower toe. Fig. 11.

	Area	Lever Arm	Moment
Upper cut-off wall	(27)	X (27.75)	= 749
Foundation slab	(25.5)	X (12.75)	= 325
Lower cut-off wall	(4)	X (.5)	= 2
Total section	56.5		1076

Distance of center of gravity from lower toe = 1076 ÷ 56.5 = 19.08.

Assuming the weight of a cu. ft. of concrete in water to be 90 lbs., the excess weight of 1 lineal foot of the foundation will be:

90 lbs. x 56.5 = 5085 lbs. (1)

which acts through its center of gravity.

When the needles are up, the resultant of the pressures which they sustained may be expressed as

$$\text{Resultant Pressure} = \frac{(15.5)\ (62.5)\ (15.5)}{2} = 7508 \text{ lbs.} \quad (2)$$

This discussion is limited to a consideration of the hydrostatic pressures when the dam is full; moreover, the downstream batter to the needles has been neglected, as the deviation from the vertical is very slight.

The point of application of this resultant is 2-3 the depth of the needle.

Combining (1) and (2) it is shown in Fig. 11 that their resultant cuts within the middle third of the foundation profile.

It should be clear since the needles are supported at the bottom and at the 2/3 point that the two reactions will each be:

$$\frac{7508}{2} \text{ lbs.} = 3754 \text{ lbs.}$$

The resultant pressure sustained by the needles is thus resolved into two parallel and equal components, of which one is overcome by the resistance of the rod imbedded in the sill, and the other acts through the U-bolt and forms the horizontal component of the stress in the inclined tie rod.

The position adopted for the line of needles resulted from the following considerations, in which an endeavor was made to eliminate any tendency towards bending in the floor slab by inclining the tie rods at such an angle that the vertical component of their stress will just equal or be less than the weight of the concrete in the upper cut-off wall.

Referring again to Fig. 11.

The weight of 1 lineal foot of upper cut-off wall will be: 90 lbs. X 27 = 2430 lbs.

To make V = weight of upper block = 2430 lbs. (No bending in floor slab.)

$$V = H \div \tan\angle = \frac{H}{x/y} = \frac{Hy}{x}$$

$$\text{or } x = \frac{Hy}{V} = \frac{(3754)\ (10.667)}{2430} = 16.5$$

$$T = H \div \sin\angle$$
$$= 4470 \text{ lbs.}$$

Theoretical deductions for maximum bending moment, needles fixed at bottom and 2/3 point.

Referring to the pressure diagram (Fig. 12).

Let $R_1 = R_2$ = reactions at bottom and 2/3 point.

Mx = bending moment at any section x distant from the bottom.

h = length of needle.

a = constant = 62.5 = wt. of cu. ft. water.

x = distance from bottom to any section.

Pc = resultant pressure on cantilever portion.

Also as shown in the diagram the total pressure between any section x and the bottom may be represented by Pr and Pt.

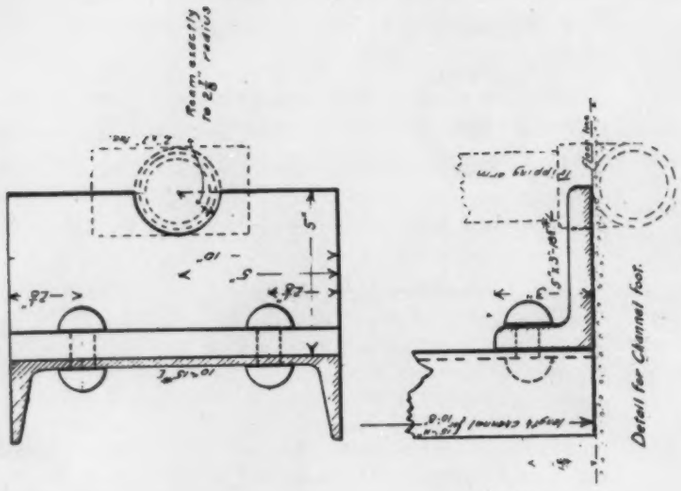


Fig. 8.

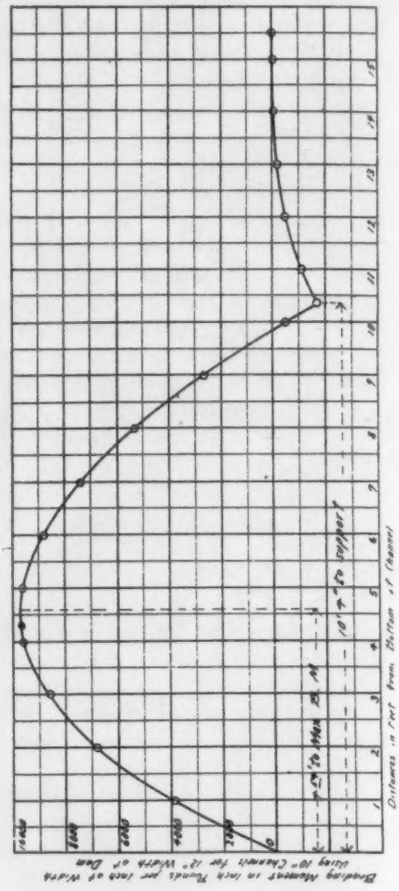

Bending Moments in Inch Pounds per Inch of Width using 10" Channels for 12" Width of Dam
Distance in Feet from Bottom of Channel

Fig. 13. Bending Moment Diagram.

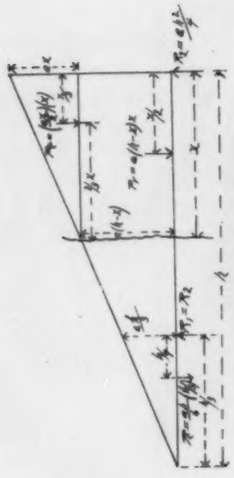


Fig. 12. Pressure Diagram.

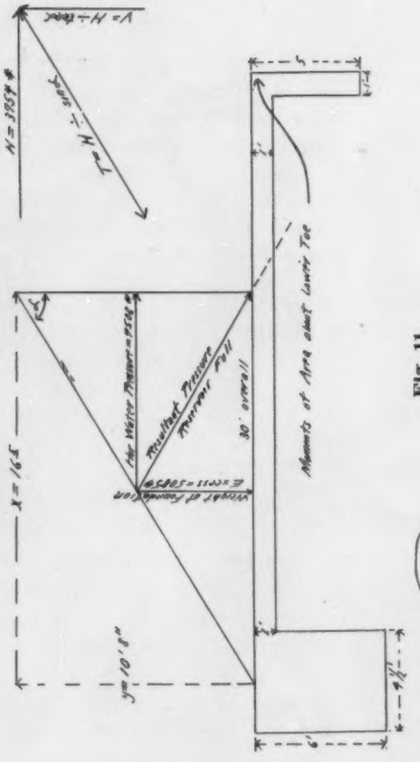


Fig. 11.

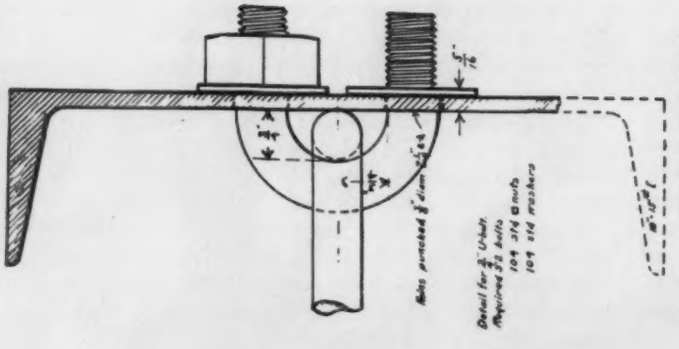


Fig. Details of Iron Work.

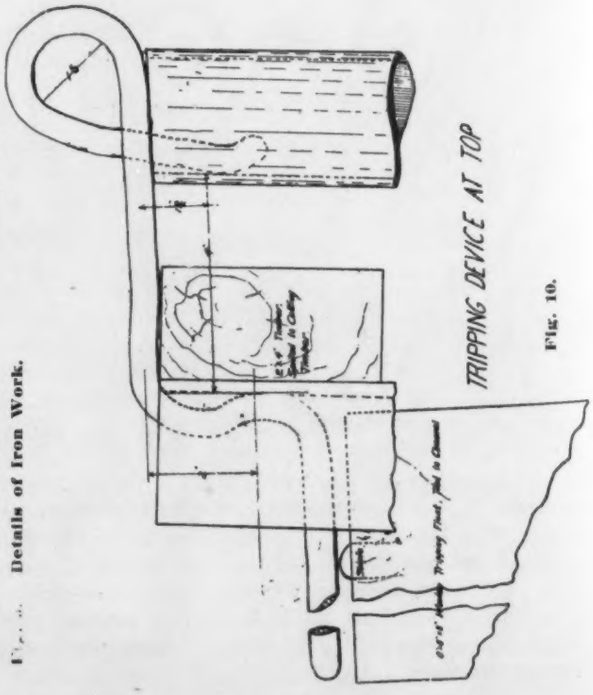


Fig. 10.

Whence, the moment—

$$Mx = R_2x\frac{2x}{3}Pt - - Pr\frac{x}{2}$$

$$= \frac{a\,h^2x}{4} - \left(\frac{ax^2}{2}\right)\frac{2x}{3} - ax\left(h-x\right)\frac{x}{2}$$

$$= \frac{a\,h^2x}{4} - \frac{ax^3}{3} - \frac{ax^2h}{2} + \frac{ax^3}{2}$$

$$= \frac{a\,h^2x}{4} - \frac{ax^2h}{2} + \frac{ax^3}{6}$$

$$= \frac{a}{12}\left(3h^2x - 6x^2h + 2x^3\right) \ldots\ldots\ldots\ldots (1)$$

To get value of x for maximum M.

$$\frac{dM}{dx} = \frac{a}{12}\left(3h^2 - 12\,hx + 6x^2\right) = 0$$

or $2x^2 - 4\,hx + h^2 = 0$

WHENCE:

$$x = \frac{4h}{4} \pm \left(\frac{\sqrt{16h^2 - 8h^2}}{4}\right)$$

$x = .293\,h \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$

Substituting this value of x in the general expression for bending moment we have:

$$M\ max. = \frac{62.5}{12}\left(.879\,h^3 - .514^{\,3} + .050\,h^3\right)$$

$2.16\,h^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$

Considering the cantilever portion of the needle.

$$M\ max = \left(\frac{ah^2}{18}\right)\left(\frac{h}{9}\right)$$

$= .376\,h^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$

$Mx = 12.5\,(x-h)^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$

Fig. 13 is a bending moment diagram in which the B. M. is expressed in inch pounds per inch in width, using 10-inch channels for 12-inch width of dam. The B. M. in inch pounds per inch of width = 1.2 B. M. in foot pounds per foot of width.

The diagram was calculated from the following formulae:

B. M. $= 6.25\,(3h^2x - 6x^2h + 2x^3)$; below 2/3 point.

B. M. $= 12.5\,(x-h)^3$ above 2/3 point.

Substituting the value of $h = 15.5$ and $x = 4.54$.

$M\ max = 9660$

If the greatest intensity of fibre stress be taken at 10,000 pounds per sq. inch = k

$$\text{then } \frac{M}{k} = \frac{9660}{10000} = .96 = \text{section modulus.}$$

As the section modulus of a 10-inch, 15-lb. channel is = 1.17, that size channel fulfills the requirements.

The dam was designed by Messrs. F. H. Tibbetts and P. A. Haviland, engineers in charge of the Pleasanton Reclamation Project. The erection was done under the supervision of Mr. Tibbetts, who was represented in the field by the writer.

Officers of the Alameda Sugar Company are: John L. Howard, president; E. C. Burr, vice-president and general manager. The offices of the company are in the Hansford Building, San Francisco, Cal.

The contractors for the foundation and imbedded metalwork were the E. B. & A. L. Stone Co., Elmhurst, Cal., of which Mr. D. U. Toffelmier is superintendent.

CURRENT COMMENT.

Coffee roasting by electric heat is one of the latest industrial applications of electricity.

The first electric steel furnace in Belgium has been started by the Cockerill Company of Seraing.

Single-phase traction is recommended in a report prepared in the Swedish State Railways by R. Dahlunder as best adapted to Swedish conditions. He also favors 25 cycles.

Gas for oxyhydrogen flame may be obtained by electrolytically decomposing acidulated water, pure water not supplying a large enough proportion of hydrogen. This method has not yet proven commercially practical.

Hydrogen from water gas may be obtained by passing the gas through a receptacle filled with inert material over which cuprous chloride trickles. The carbon monoxide is dissolved in the cuprous chloride and practically pure hydrogen is liberated. The carbon monoxide is afterwards extracted by pumping in vacuum and burned under the gas generator.

The first English single-phase electrification of an existing steam road is that of a ten mile double track section of the Midland Railway, between Heysham, Morecambe and Lancaster Alternating current will be used at 6,600 volts, 25 cycles. A nine mile double track section of the London, Brighton and South Coast section is also being furnished with overhead electric transmission.

Nominations for the A. I. E. E. election in May are as follows: President, Mr. L. B. Stillwell, New York City; vice presidents, Messrs. J. J. Carty, New York City; Paul M. Lincoln, Pittsburg; Paul Spencer, Philadelphia. Managers, Messrs. A. W. Berresford, Milwaukee; W. S. Murray, New Haven; H. H. Norris, Ithaca; S. D. Sprong, New York. Treasurer, Mr. George A. Hamilton, New York City. Secretary, Mr. Ralph W. Pope, New York City.

Examination for Assistant Physicist is announced by the United States Civil Service Commission, on April 21, 1909, to fill ten or more vacancies in the positions of laboratory assistant (in physics) and assistant physicist in the Bureau of Standards, at salaries varying from $900 to $1,200 per annum for laboratory assistant, and from $1,400 to $1,800 per annum for assistant physicist, and vacancies requiring similar qualifications as they may occur.

Utilization of atmospheric nitrogen is accomplished by a new process devised by the Westdeutsche Thomas Phosphat Werke of Berlin. Electric discharges in exploding a mixture of air and hydrogen produce a rapid temperature rise, which forms peroxide of nitrogen. At ordinary temperature this is a gas which unites with water to form nitric and nitrous acid. At thirty degrees below zero it is a crystalline solid. A combustible vapor or gas, such as ether, may be substituted for hydrogen, or the same temperature rise followed by sudden cooling may be obtained by blowing powdered calcium peroxide into an electric arc, producing calcium nitrate.

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A. H. HALLORAN, Secretary and Managing Editor

DIRECTORS
R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1897 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Another Pioneer.

New conditions in a new country require new methods. This has been exemplified in the West, not only by radical departures from established precedent in mining and agriculture, but also in power production and utilization. Foremost in originality has been the pioneer work in long distance transmission of hydro-electric power. In the same list should be included the impulse water wheel, the cable railway of Hallidie, the oil-water-gas process of Lowe, and successful fuel oil burning. Recently, there is the 1200-volt direct-current railway.

Such a road between Stockton and Lodi in California is said to be the first in this country. An article on its operation by Mr. S. B. McClenegan is interesting, not so much for its comparative data, as it is for its descriptive and suggestive details. The motors, which are of the commutating pole type, operate under 1200 volts. Direct current is supplied by a third rail. The equipment has been designed for a much greater mileage than has yet been completed and consequently the power factor is too low to be used as a basis for comparing the economy of this with that of other systems.

The 1200-volt railroad is the direct result of the demand for higher voltages for interurban work. While it is admitted that the low voltages in use for city traction are eminently satisfactory, it must also be allowed that for interurban service, involving long distances, the cost of frequent sub-stations becomes prohibitive. By doubling the voltage the same power can be transmitted four times as far with equal economy. Other factors bring down this ratio so that with double the voltage half the number of sub-stations is required.

It is still too early to institute comparisons between this and the single - phase or three - phase alternating current systems. Each has obvious advantages for certain kinds of service. but no one is of universal application. Every discussion of their relative merits involves the improbable, ubiquitous "if." Whistler, the artist, in referring to his failure to pass the West Point examinations, said: "If silicon was a gas I would have been a major-general by this time." If conditions were such and so, the other systems might give better results. Existing conditions have been well met by some one of these systems and it seems fruitless to discuss a matter whose possibilities are not fully developed. Far better it is to admire the courage and the persistence of those who are not only blazing the trail, but also removing many of the obstacles, so that the way will be easy for those who follow.

CURRENT COMMENT

Canadian electric railways constructed 33 miles of track during 1908, as compared with 72 miles during 1907.

Electrification of Italian railways is to be started in several sections by the Italian railroad commission under an appropriation of seven million dollars.

Electrification of steam railroads was discussed by the New York Railroad Club on March 19. Dr. William McClellan outlined the development of electric railways and systems. The discussion that followed showed the superiority of electric traction.

The electric locomotives of the Great Northern Railroad are the most powerful locomotives in existence, each utilizing two thousand horse-power three-phase electric current. The Westinghouse Company is designing a 2,750 h. p. single-phase locomotive.

A new mantle for incandescent gas lighting will soon be on the market. It is claimed that these mantles will burn one thousand hours without appreciable loss of efficiency and are strong enough mechanically to submit to collapse with impunity after being burned off.

"Economy coils" are small transformers that lower a high-voltage current so that low-voltage tungsten lamps may be used. It will probably be but a short time before these become of commercial value, as the tungsten filament is not so fragile if made for low voltage.

A water supply for Manila has been obtained from the Mariquina River, twenty miles north-east of the town. The watershed covers 140 square miles and the installation includes 10½ miles of 42 inch steel pipe and 4½ miles of concrete tunnel. A reservoir capable of holding fifty million gallons has been built and the plant has a capacity of twenty-two million, five hundred thousand gallons daily.

The transformer as a funnel is learnedly explained in a recent issue of the "Saturday Evening Post." "The electricity is furnished by the generator in varying quantities—sometimes more, sometimes less. But the transformer acts like a funnel, the current coming out of it always in a stream of a certain size. This, of course, is a matter of utmost importance, inasmuch as the electric 'fluid' could not be utilized satisfactorily for lighting, for running machinery, or for any other purpose, if the quantity of it delivered were constantly varying."

Mercury makes meters run slow according to experiments made by Herr J. Busch as described in the Electro technische Zeitschrift. A motor meter which had been running satisfactorily on a 110-volt circuit, 10 amperes normal load was 5 per cent, 15.3 per cent and 21.6 per cent slow at full load, half load and tenth load respectively, four days after a small piece of amalgated brass had been placed in it. This error increased with time and is due to a deposit of mercury in the commutator. The experiments show the bad effects of mercury near such meters.

PERSONALS.

S. K. Colby, treasurer of Pierson, Roeding & Company of San Francisco is in Portland.

A. D. Skinner, sales engineer for the Skinner Engine Company of Erie, Pa., is in San Francisco.

John D. Sutton, electrical contractor of San Francisco, accompanied by Mrs. Sutton, sailed for Vancouver this week to look after some contracts he has there.

A. B. Vandercook of the San Francisco office of the Telephone-Electric Equipment Company has returned from a very successful two weeks' business trip to Los Angeles.

J. H. Klinck, representing the industrial and power department of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from Seattle on his way to Pittsburg.

Albert Schuler, formerly connected with the Chicago office of the Stromberg-Carlson Telephone Manufacturing Company as telephone engineer, has taken charge of the telephone department of the Telephone-Electric Equipment Company, who represent the Stromberg-Carlson Company on the Pacific Coast.

NEWS OF THE STEAM ENGINEERS

San Francisco No. 1, N. A. S. E., will hold a called meeting next Thursday evening, April 1st, to take action looking to their affiliation with the California State Association, N. A. S. E.

The meeting of April 8th will be entertained by a lecture on air lift pumps, by Mr. Sam Skelly of Alameda.

A. T. PERRY, Secretary.

HOW TO LIGHT RAILWAY CARS.

A comparision of the different ways of lighting railway trains by electricity, showing the advantages and defects of each method, has just been published in a bulletin entitled "Investigation of Methods of Railway Train Lighting," in the engineering series of the University of Wisconsin. The author, Edward Wray, received his degree of electrical engineer at the university in 1906.

After tracing the advance of lighting methods in railway cars from the single candle used in English coaches in 1825, through early experiments with oil lamps and adapations of all the various methods used in lighting streets and houses, Mr. Wray describes the storage battery equipments, steam driven generators in baggage cars, and axle generating equipment in individual cars.

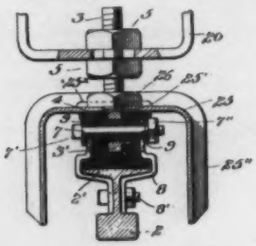
"It is impossible to make a sweeping claim of superiority for any one type of equipment," says the author. "Each is more or less applicable to certain kinds of service. The success of any of the types of lighting equipment lies largely in the hands of the railway operating department. The simplest of all the electrical equipments is undoubtedly the straight storage equipment." Storage batteries, however, must be charged each day, the bulletin points out, requiring expensive charging stations at terminals, and making this mode of lighting impractical for long overland runs. For short runs with heavy traffic and a large number of cars, the storage battery is most economically operated.

Steam-driven generators are also comparatively simple, but require an attendant, and demand that the train be a unit, not allowing any car to be introduced which has not that system of wiring. Thus they are most applicable to trunk line trains with a definite run, especially overland trains.

For a large number of cars the only suitable method of lighting by electricity is that in which the power is generated by the axle of the car, says the author. Though the machinery is complicated, and gets out of order easily, necessitating constant attention, it is one which makes each car an independent unit, so that it may be used either in block trains or on miscellaneous runs.

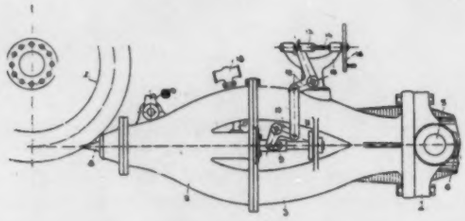
PATENTS

915,375. Insulating third-rail support. Daniel M. Pfautz and John L. Luckenbach, Philadelphia, Pa., assignors to The American Suspension Railway Company, Philadelphia, Pa. In a third-rail support, a depending third-rail; opposed hanger-plates each having a portion contacting with the web of the



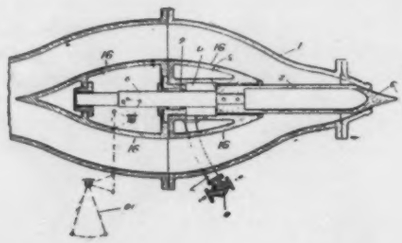
rail and bolted thereto, a portion outwardly bent contacting with the base of the rail, and an upwardly projecting portion; an insulating block with which said upwardly projecting portion engages and to which it is bolted; and means for supporting the insulating block from the elevated structure.

915,277. Water-wheel nozzle. George F. De Wein, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. A curved passage, pivoted nozzle having the center line of its discharge and the center line of its inlet coincident and



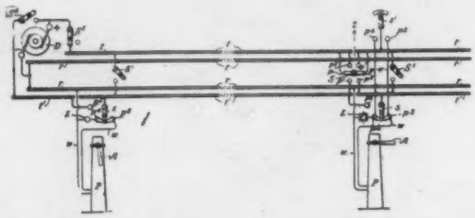
said coincident center lines intersecting the axis of the pivot bearing, and means for throttling extending outside of the nozzle and having the outside portion located adjacent the concave side of the curved portion of the nozzle.

915,214. Nozzle. Arnold Pfau, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. The combination with a curved-passage nozzle having an aperature, of a needle extended through the curved walls of said nozzle and having the outer portion located adjacent the concave side



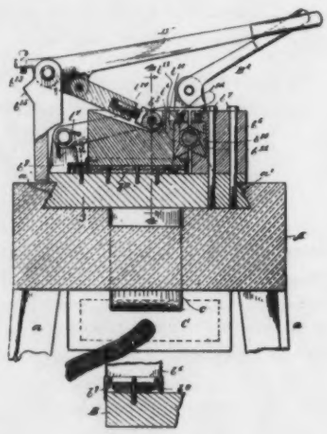
of the curved portion of the nozzle and directly accessible from without the nozzle walls and adapted to control the thoroughfare through said aperature, the space between the portion of the needle within the nozzle and the opposite walls of the nozzle being symmetrically enveloped about said needle portion.

915,189. Safety system for electric railways. Charles J. Kintner, New York, N. Y. In a railway system a continuous third rail or contacting conductor connected to a source of electrical energy; a switching device carried by each car or train for automatically disconnecting the motor thereof from the source of power which drives it; in combination with semaphore arms located at intervals beside the track for automatically actuating said switching devices; together with electromotive devices for operating said semaphore arms,



said electromotive devices being included in circuit with sectional third rails or conductors parallel with the track and each car or train provided with means for cross connecting said sectional conductors successively to the continuous third rail or contacting conductor, the arrangement being such that when a car or train is passing over a given section of the road any car or train immediately following the same will be automatically stopped, should it approach too closely to the first-named car or train.

915,249. Apparatus for welding by electricity. Charles E. Thompson, Cleveland, Ohio, assignor, by mesne assignments, to The Electric Welding Products Company, Cleveland, Ohio. In apparatus of the class described, an electrode comprising a base plate forming one terminal of the heating electric circuit, a block fixedly mounted upon said plate, a



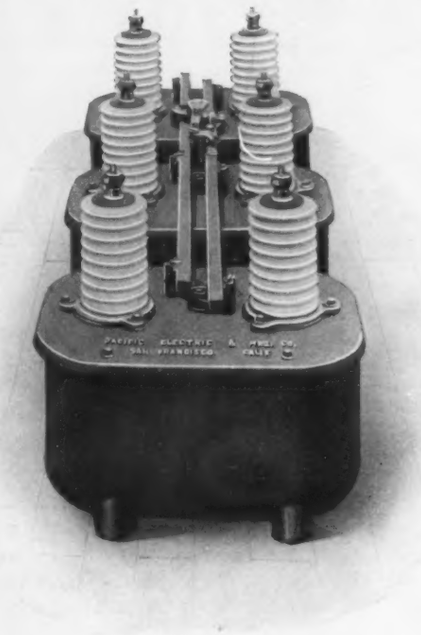
second block mounted upon said plate so as to be moveable in a direction transverse with respect to the direction of movement of the latter, and clamping dies removably secured upon the contiguous faces of the respective blocks, said dies being formed to substantially encompass one of the parts to be joined, and both said blocks having approximately equally direct electrical connection with said last named electrode, whereby a uniform distribution of current is had in such part, substantially as described.

INDUSTRIAL

PACIFIC ELECTRIC & MANUFACTURING COMPANY.

The Pacific Electric & Manufacturing Company, which has been engaged in the manufacture of oil switches, circuit breakers and pole-top line switches for handling power lines at high voltages, have recently moved their factory from Napa to a new building at 80 Tehama street, San Francisco. With this move they have greatly increased their facilities for turning out switches and developing the new models for the higher voltages now coming into use and for working up the various control systems demanded by modern practice.

They have recently developed an excellent little 33,000 volt switch, which is a modification of their well-known 60,000

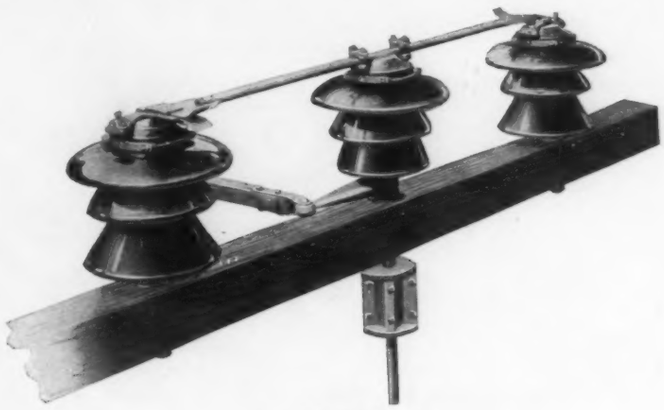


33,000 Volt Switch.

and 80,000 volt type, a cut of which is shown below. The features that will appeal to the engineer in this switch are that the tank is of cast iron in one piece, obviating the possibilities of leaking or dripping, which are always present with wood, fibre or sheet-metal tanks. There are no wood parts in the oil, and the current is carried by a one-piece, cast brass, moving contact, doing away with the necessity of any links, hinges or complicated motions; the contact clips are rigidly alligned and all the contact parts are readily and quickly removable, and the parts, made to standard forms, can be replaced by loosening a readily accessible nut. All parts of the switch are suspended from and firmly held in the cast-iron tank cover and can be lifted clear of the oil without emptying the switch or lifting any submerged frame or supports. The control is so arranged that the switch cannot be left partly closed, and all switches of this type can be fitted with an automatic trip at any time after the switch is in place. The porcelain is not under tensile strain, is ample in cross section, has large creepage surface and is held in long, cemented bearing surfaces, eliminating the possibility of electrical or mechanical trouble.

The switch can be furnished with ground insulators if required and with a remote electrical control. The contact buttons for the control are enclosed in a cast-brass case, which is fastened to the front of the board so that it is not necessary to drill the marble of a switch-board for lamps or control levers, everything but the control-wire lead-outs being encased in this box.

The pole-top switch also shown on this page is the well-known type developed for Pacific Coast use, and is now installed on many of the large transmission systems in the West. It is of simple construction and so arranged that all the contacts can be opened simultaneously from the ground; the details have been worked out in such a way that the switch will not stick or bind even after long exposure to the weather. This company has now been engaged for over two years in switch construction and has met with considerable success in this special field.



Pole Top Switch.

NOTABLE ADDITION TO HEALD'S COLLEGE.

Thomas J. Kirk, ex-Superintendent of Public Instruction of California, is now vice-president of Heald's Business College, of San Francisco, with branches in a number of California's towns. Besides the regular business college, instruction is also given in mining, electrical, mechanical, civil, steam, gas and automobile engineering.

TRADE CATALOGUES.

The Pelton Water Wheel Company, of San Francisco and New York, have issued the eleventh edition of their catalogue on the Pelton Water Wheel. This is the most artistic and comprehensive catalogue yet issued on this subject. The numerous illustrations, whether of scenes, apparatus, methods or installation, are of the highest class, as are also the typography, press work and binding. The 116 pages of this catalogue contain more of interest and value than is found in the usual text book on hydraulics. In addition to the impulse wheel, for the first time is illustrated and described the Pelton-Francis turbine, as well as governors, gate valves, pipe and all accessories appertaining to water power installations.

TRADE NOTE.

The electrical trade generally, will be interested in knowing that the cross-arm business of the Walworth & Neville Manufacturing Company, pioneers in the cross-arm business, was, under date of March 1st, transferred to a new corporation, the American Cross-Arm Company, who have taken over the entire business of the old company and will continue in the old offices of that company in the Heyworth Building, Chicago. Mr. W. M. Carpenter, President, and Mr. A. F. Crosby, sales manager, continue in charge of the business.

NEWS NOTES

TRANSPORTATION.

LOS ANGELES, CAL.—Bids will be received till April 26th for the sale of a street railway franchise on certain streets in this city.

MODESTO, CAL.—The San Joaquin Valley Electric Railroad Company has purchased a franchise on Ninth street in tihs city.

SAN MATEO, CAL.—E. M. Warn has applied to the City Trustees for a franchise to construct an electric line from this city to the beach.

LOS ANGELES, CAL.—The Los Angeles Railway Company has been granted a 21-year franchise to operate an electric line on certain rights-of-way in this city.

ASTORIA, ORE.—Council has passed an ordinance granting a 30-year franchise to the Oregon Coast Railway for the construction of an electric railway over certain streets.

VALLEJO, CAL.—City has received an application from Randall, Wright & Trowbridge of Oakland for a franchise for an electric road to White Sulphur Springs and Benicia.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has petitioned for a 30-year franchise to extend its lines through Fairview to connect with the O. R. & N. steam line.

NORTH BEND, ORE.—The Coos Bay Electric Company has petitioned for a 30-year franchise to construct an electric line from Marshfield to North Bend.—S. H. Bell, Representative.

BOZEMAN, MONT.—The contract for the construction of a 20-mile electric railway between Bozeman and Salesville has been awarded to Westinghouse-Church-Kerr Company of New York.

ANACONDA, MONT.—The construction of an electric railway from Anaconda to Hamilton is under consideration. The road will be about 60 miles long. A. M. Walker, Anaconda, is reported to be interested.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway Company has been granted a franchise to construct standard-guage lines on certain thoroughfares in this city. Beginning April 11 a new service over the Fifty-fifth street line is to begin.

PLUM, WASH.—Seattle Capitalists have organized a company for the purpose of building an electric line from Plum, Wash., on the Columbia river, to Coulee City; distance 50 miles. A power sight at Monoghan Rapids, about 12 miles from Plum, will be developed.

VALLEJO, CAL.—Manager McIntyre and Attorney John T. York of the Napa Valley electric road have conferred with the Board of City Trustees in reference to the new franchise sought by the company to build a loop line through the eastern section of the city and also to secure permission to cut the grade of Sonoma street.

TACOMA, WASH.—The Thunder Creek Transportation & Smelting Company has been incorporated by A. M. Richards, W. W. Shenk, F. S. Blattner of Tacoma, Chas. E. Phoenix of Bellingham, and George Senior of Seattle with a capitalization of $3,000,000 to build an electric or steam railway and a telephone and telegraph line along Thunder creek in Whatcom and Skagit counties.

FRESNO, CAL.—Engineering work has been started for the proposed Fresno-Hanford interurban line, and it is expected that active construction work will be started by April 1. All construction work will be done from Fresno end of the line. F. S. Granger, Hughes Block, Fresno, is promoter of the line. The road is financed by the Cleveland Construction Company, W. E. Davis, President, Cleveland, O.

FRESNO, CAL.—Bonds amounting to $1,000,000 for the proposed Fresno-Hanford Interurban Railroad will be purchased by the Cleveland Construction Company. Grading on the new road begins on April 1st. Vice President and Chief Engineer W. E. Davis of the Eastern company is expected to arrive about April 1st. He will supervise all of the work of construction.

OAKLAND, CAL.—The February statement of the San Francisco, Oakland & San Jose Railway Company compares with February, 1908, as follows:

	1909.	1908.
Gross earnings	$68,590 51	$68,407 38
Operating expenses	33,151 45	35,463 95
Net earnings	$35,439 06	$32,943 43
Fixed charges	23,142 06	20,851 90
Surplus	$12,297 00	$12,091 53

OAKLAND, CAL.—The February statement of the Oakland Traction Company compares with February, 1908, as follows:

	1909.	1908.
Gross earnings	$205,100 51	$210,591 13
Operating expenses	102,258 16	110,303 22
Net earnings	$102,842 35	$100,287 91
Fixed charges	45,367 32	45,830 74
Surplus	$ 57,475 03	$ 54,457 17

The decrease in gross earnings in February was $5,400, compared with a decrease of $10,500 in January. The surplus increased $3,000, as compared with a small decrease in January.

FINANCE.

BAKERSFIELD, CAL.—The Springfield Oil Company has levied an assessment of 2 cents per share on the capital stock of the company.

BAKERSFIELD, CAL.—The Loveland Oil Company has levied an assessment of 7 cents per share on the capital stock of the company.

VISALIA, CAL.—The Wutchumne Water Company has levied assessment No. 130 of $10 per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The Union Oil Company has levied assessment No. 1 of 10 cents per share on the capital stock of the company.

BAKERSFIELD, CAL.—The Bakersfield Fuel & Oil Company has levied an assessment of $100 per share on the capital stock of the company.

TACOMA, WASH.—Bids will be received April 5 for $300,000 electric light and power system bonds—John F. Meads, Comptroller; Ray Freeland, Treasurer; J. W. Linck, Mayor.

SAN LUIS OBISPO, CAL.—An election for the issuance of bonds amounting to $180,000 for municipal improvements has been called. The city contemplates expending $80,000 for improving the water system; $60,000 for extending the sewer system, and $40,000 for other improvements.